

XXVIII.—On the Fossil Botany and Zoology of the Rocks associated with the Coal of Australia. By FREDERICK M'COY, M.G.S. & N.H.S.D. &c.

[Continued from p. 236.]

[With nine Plates.]

(*Lamellibranchiata.*)

Pecten squamuliferus (Mor.).

Common in the fine, olive-coloured schists of Wollongong, N. S. Wales.

Pecten ptychotis (M'Coy). Pl. XIV. fig. 2.

Sp. Char. Ovato-orbicular, width very slightly exceeding the length, convex, smooth; ears unequal, posterior one obtuse-angled, undefined, anterior ear narrow, square at its extremity, divided by a deep, acutely angular sinus, from the body of the shell; surface smooth, except the extremity of the anterior ear, which is longitudinally plicated.

It is only by the plication of the extremity of the anterior ear that this can be known from the *P. variabilis* (M'Coy) so abundant in some of the carboniferous shales of Ireland. Length 4 lines, width one-fourth of a line more.

Common in the shale of Dunvegan, N. S. Wales.

Pecten sub-5-lineatus (M'Coy). Pl. XVII. fig. 1.

Sp. Char. Truncato-orbicular, convex, equilateral, beaks tumid; ears large, nearly equal, flattened, the posterior one slightly pointed and separated at the margin from the body of the shell by a deep rounded sinus; anterior ear broad, nearly square, with a slightly convex margin; surface of both ears and body of the shell marked with a few obtuse concentric waves of growth, and radiated with rather coarse narrow rounded ridges, those of the ears being close and equal, while those of the body are rather distant from each other, the interspaces being flat; about twenty-five proceeding directly from the beak to the margin, where they are about two lines apart; between those at a short distance from the beak are interpolated an equal number of rather thinner ones, which again receive nearer the margin two fine striæ between each of them and the adjoining primary ridge.

The striation of this fine species resembles that of the *P. quinquelineatus* (M'Coy, Syn. Carb. L. Foss.); that is to say, near the margin and towards the middle of the shell there are five striæ between each pair of primary ones, the middle or odd one of the

five nearly equalling the primary ridges in thickness. The present fossil has however much finer striæ than the Irish species alluded to, and the arrangement is much less definite, becoming confused in size and number towards the sides; it is also distinguished by its greater convexity. Length 2 inches 9 lines, width the same.

Rare in the greenish, fine sandy, beds of Harper's Hill, N. S. Wales.

Avicula tessellata (Phil.).

I cannot distinguish the specimens occurring in the soft greenish schists of Dunvegan, N. S. Wales, from those in the precisely similar shale at the base of the carboniferous series at Lisnapaste in the north of Ireland.

Pterinea macroptera (Mor.).

Rare in the white rock of Port Arthur, V. D. Land.

Eurydesma cordata (Mor.).

Common in the arenaceous limestone of Arthur's Hill, N. S. Wales.

Inoceramus Mitchellii (M'Coy). Pl. XIV. fig. 1.

Sp. Char. Longitudinally ovate, one-fifth longer than wide, slightly oblique, inflated; hinge-line oblique, nearly equalling the width of the shell, forming a slightly compressed wing; beaks pointed, prominent, incurved, close to the anterior end; anterior side nearly straight, abruptly subtruncate; surface with numerous strong, concentric, irregular wrinkles of growth.

The hinge-margin of this species is much thickened, which removes it from *Posidonia*, while, as in many of the German cretaceous *Inocerami*, it is not possible to observe any traces of the transverse ligamentary pits, nor can we be sure whether those species possessed them or not; meanwhile I shall leave the present species in the same genus as its obvious allies alluded to; and even if future research should prove that ligamentary pits did not exist, we should form a distinct genus for those species, which, like the present and the *I. vetustus* (Sow.) of the mountain limestone, are distinguished from the true semimembranous *Posidonie* of the lias and palæozoic shales with which they have been confounded, by their thick shells, general form, and thickened hinge-margin. Length 2 inches 3 lines, width 1 inch 9 lines, thickness about $1\frac{1}{2}$ inches.

Common in the sandstones of Glendon and Wollongong, N. S. Wales.

Dedicated to Sir T. Mitchell, one of the first to make known the existence of fossils in those rocks.

Pleurorhynchus australis (M'Coy). Pl. XVI. fig. 4.

Sp. Char. Alæform or transversely subtrigonal, gibbose, length nearly two-thirds the width; posterior side forming a compressed narrow wing; anterior face obliquely subtruncate, convex, divided into three nearly equal tumid compartments by two impressed furrows from the beak; body of the shell and posterior side radiated with rather coarse irregular ridges from the beak; anterior face finely striated longitudinally.

This resembles the *P. minax* (Phil.) in the striation of the anterior face being so much finer than that of the middle or posterior parts of the surface; it differs in having the anterior face not only much more finely striated, but divided into three parts by distinct furrows; while from the *Cardium irregulare* and *C. strangulatum* (Kon.), which have the anterior face so divided, but smooth, it is distinguished by this latter character, and also by wanting the mesial strangulation of those species. Length of small specimen 8 lines, width 1 inch.

Not uncommon of larger size in the sandy schists of Wollongong, N. S. Wales.

Allorisma curvatum (Mor.).

Common in the sandstones of Darlington, Wollongong and Glendon, N. S. Wales.

Orthonota compressa (Mor.).

In the calcareous schists of Harper's Hill, N. S. Wales.

Orthonota costata (Mor.).

Common in the sandstone of Wollongong, N. S. Wales.

Modiola crassissima (M'Coy). Pl. XV. figs. 2 & 3.

Sp. Char. Transversely ovate, very gibbose; beaks small, nearly terminal; anterior side forming a small rounded lobe beneath the beaks, separated from the body of the shell by a strong sinus in the ventral margin, from which a shallow concavity runs towards the beak; posterior side wide; hinge-margin elevated, four-fifths the width of the shell in length, compressed, angulated, posterior end broadly rounded; ventral margin convex; shell very thick; surface with a few concentric waves of growth, and marked towards the posterior inferior angle with a few distant obsolete ridges extending obliquely from the beaks.

Length 5 lines, width 1 inch 7 lines, height of cardinal angle 11 lines (occasionally $3\frac{1}{2}$ inches wide).

Not uncommon in the schists of Harper's Hill, N. S. Wales.

Pachydomus carinatus (Mor.).

Abundant in the fine sandy schists of Wollongong, N. S. Wales; more rare in the white rock of Port Arthur, V. D. Land.

Pachydomus globosus (Sow. sp.).

Common in the sandstone of Wollongong, N. S. Wales.

Pachydomus gigas (M'Coy). Pl. XVI. fig. 3.

Sp. Char. Transversely oval, length two-thirds of the width, very gibbose, inflated; beaks very large, incurved, placed in about the anterior third of the shell; posterior side obliquely truncated, the angles rounded; posterior slopes compressed, flattened; posterior ridge obtusely rounded, almost disappearing before reaching the posterior inferior angle; anterior side small, narrowed, with a slightly marked sinus between it and the convex ventral margin; surface marked with small concentric cord-like sulci and ridges.

This is distinguished from the *P. globosus* (with which Mr. Morris seems to include it) by its greater width in proportion to the length, by the flattened, compressed sides of the posterior slopes and the more oblique truncation of the posterior end, and the smallness and narrowed appearance of the anterior side, arising from a slight, but always perceptible, sinus between it and the convexity of the ventral margin. The shell is very thin in this species, which makes a near approach to *Leptodomus* (M'Coy) in all its characters. Length $4\frac{1}{2}$ inches, width 6 inches 3 lines (often much larger).

Common in the fine sandstone of Wollongong, N. S. Wales.

Pachydomus sacculus (M'Coy). Pl. XIV. fig. 5.

Sp. Char. Subquadrate or satchel-shaped, length nearly equalling the width, thickness two-thirds the length; gibbose towards the beak, compressed towards the ventral margin; beaks large, nearly central, strongly incurved towards the anterior side; posterior side forming a short, compressed, rectangular wing; anterior side very obliquely truncated; anterior and posterior slopes abruptly rounded, and the angles formed by their junction with the ventral margin equal, broadly rounded and nearly equidistant from the beak; abdominal margin broadly concave, giving the middle of the valves a flattened, slightly hollowed appearance; shell very thick, foliaceous; surface with a few obtuse concentric elevations and numerous irregular concentric lines of growth.

Length $4\frac{1}{2}$ inches, width 4 inches 9 lines. I am uncertain whether the specimen figured is from Black Head or Wollongong, N. S. Wales.

Pachydomus ovalis (M'Coy). Pl. XIV. fig. 4.

Sp. Char. Transversely oval, length five-sixths of the width, compressed, thickness rather more than two-thirds of the length; beaks tumid, nearest the anterior end; anterior and posterior ends oval, rounded, the latter obscurely angulated at end of hinge-line; ventral margin regularly convex; surface marked with thick, unequal, cord-like concentric striæ; lunette deep ovate; ligament external, large.

The anterior and posterior adductor impressions are large and oval; the impression of the retractor of the foot very small, lunate, just over the anterior adductor; pallial impression with a small rounded sinus before joining the posterior adductor. Distinguished from the *P. levis* (Sow.) by the coarse concentric lineation of the surface. Length 1 inch 8 lines, width 2 inches.

Very common in the sandstone of Wollongong, N. S. Wales.

Pachydomus ? pusillus (M'Coy). Pl. XVI. figs. 1 & 2.

Sp. Char. Small, ovato-orbicular, width slightly exceeding the length, globose, thickness four-fifths the length; beaks very large, tumid, much incurved into the anterior cordiform space, which is unusually deep; anterior side short, rounded; posterior end rounded; ventral margin very convex; ligament very large, external; muscular impressions large, anterior deep oval, posterior impression shallow, lunate, pallial impression entire; shell thick, surface rough with strong concentric imbricating lines of growth.

This curious little species resembles an *Isocardia*, but from the great size of the external ligament, thick shell and general habit, I have placed it in the present genus, but not without doubt, from its diminutive size and peculiar proportions. Length 10 lines, width 11 lines.

Common in the sandy schists of Wollongong, N. S. Wales.

Cardinia (?) *exilis* (M'Coy). Pl. XV. fig. 1.

Sp. Char. Transversely ovate, compressed, cuneiform, slender, twice as wide as long; dorsal margin convex; beaks small, one-sixth of the width from the anterior end; posterior end attenuated, obtusely pointed; anterior side small, rounded; anterior half of the ventral margin convex, posterior half slightly concave; surface with strong irregular imbricating laminæ of growth and close intervening imbricating striæ.

This reminds us of the *Unio* (*Cardinia*) *acuta* (Sow. sp.) of the European coal-fields, but is distinguished by its greater thickness, more clavate form and arched dorsal margin. The muscular and pallial impressions correspond with those of the lias species of

the genus generally, but the dental impressions are obscure. Length 1 inch 1 line, width 2 inches 2 lines.

From the sandstone of Wollongong, N. S. Wales.

Notomya (M'Coy), new genus. (Etym. *νότος*, *auster*, and *Mya*.)

Gen. Char. Shell transversely ovate, equivalve, inequilateral, compressed, greatest thickness behind the middle of the shell; gaping slightly at both ends; beaks small, compressed; cardinal slope not distinguished from the sides of the shell; shell thick, surface concentrically lineated; ligament external, large. Cast: a wide shallow furrow runs obliquely from the beak about half-way towards the ventral margin; a shallow spoon-shaped hollow extends from the beak to the impression of the posterior adductor muscle, bounded by a low ridge on each side in each valve; traces of a simple cardinal tooth beneath the beak of the right valve; muscular impressions deep; anterior adductor large ovate, not attenuated above; posterior adductor broadly lunate; retractor of the foot small, oval, immediately over the anterior adductor; pallial impression with a small rounded sinus before joining the posterior adductor.

It is with those Muschelkalk *Myacites* of Schlotheim and Bronn, and such like forms, of which M. Agassiz, in his 'Etudes Critiques sur les Mollusques Fossiles,' has composed his genus *Pleuromya*, and with those forming his genus *Gresslya*, that the present fossils have the strongest affinity. They are however perfectly distinct from those essentially Jurassic and Triassic types, by the small size of the sinus in the pallial impression. In minor characters it differs from the *Gresslyas* in the small size of the beaks, and the more compressed form of the sides (the greatest thickness in *Gresslya* being always before the beaks, and gradually diminishing towards the posterior end, while the greatest thickness in *Notomya* is *behind* the beaks, depriving them of the characteristic wedge-like form of *Gresslya*). The present genus is destitute of the cardinal ridge in the right valve, so remarkable in *Gresslya*, having in its place a shallow, attenuated, ovate hollow, bounded by two obscure ridges in each valve, thus approaching *Pleuromya*. The shell also is much thicker than in the above genera, and the impressions of the muscular and pallial scars much deeper and more strongly marked in consequence; the impression of the anterior adductor is pear-shaped, pointed and attenuated above in *Gresslya*, but simply oval in *Notomya*. The *Pleuromyæ* differ in nearly all the same points as *Gresslya* from the present genus (except the cardinal ridge), and differ besides in the elevation or upward curvature of the cardinal line and the convexity of the posterior two-thirds of the ventral margin cor-

responding with it, those parts being oppositely inclined in *Notomya*. The oblique mesial or post-mesial furrow from the beak in the cast of *Notomya* does not exist in the other two genera, but in *Pleuromya* there exists a somewhat similar furrow, but different in position, arising *in front* of the beaks, and extending directly to the ventral margin close to the anterior end. *Cardinia* (Ag.), which somewhat resembles the present genus, is distinguished by its entire pallial impression and dental characters.

Notomya securiformis (M'Coy). Pl. XV. figs. 5 & 5 a.

Sp. Char. Transversely ovate, flattened; length two-thirds the width, thickness rather less than half the length; beaks small, flattened, rather more than one-third the width from the anterior end; anterior end narrowed, rounded; posterior end narrow, subtruncate, nearly square; anterior two-thirds of the ventral margin very convex, a shallow concavity in the posterior third; muscular impressions very large, anterior one deepest, ovate, posterior one shallow, broad, reniform; pallial scar strongly marked, parallel with the ventral margin as far as the anal angle, then a small subangular sinus before joining the adductor impression; retractor impression small, deep, narrow, oval; in the cast the oblique furrow from the beak towards the ventral sinus wide, shallow; remains of a cardinal tooth under the beak of the right valve.

Length 1 inch 6 lines, width 2 inches 2 lines, thickness 11 lines. The figures of this species display most of the generic characters. Sandstone of Wollongong, N. S. Wales.

Notomya clavata (M'Coy). Pl. XV. fig. 4.

Sp. Char. Transversely clavate; length two-thirds the width, evenly convex, greatest thickness towards the posterior half; beaks very small, compressed, rather more than one-fifth the width from the anterior end; anterior end very broad, evenly rounded; anterior third of the ventral margin very convex, middle portion widely concave; posterior end narrowed, obliquely subtruncate, rounded; muscular impression shallow, anterior large ovate, posterior broad lunate; retractor small, broad, oval; oblique longitudinal furrow from the beak deep, narrow above, widening nearly to the marginal concavity; impression of one simple cardinal tooth beneath the beak of the right valve; the long spoon-shaped hollow extending from the beaks to the posterior muscular impressions, and its lateral bounding ridges obscurely marked.

Distinguished from the *N. securiformis* by its broadly rounded anterior side, smaller beaks, thinner shell, and consequently more faintly marked ridges and impressions on the cast, and by the

middle of the ventral margin being concave instead of very convex, and the sides evenly convex instead of flattened. Length 1 inch 6 lines, width 2 inches 2 lines. Common in the sandstone of Wollongong, N. S. Wales.

Besides the above, there is a third species of *Notomya* equally common in the sandstone of Loder's Creek, but of which none of the specimens were good enough to figure or describe; it has the strong mesial oblique furrow from the beak of the cast, small sinus in the mantle scar, and other characters of the genus, but differs from the preceding species in its regular oval outline, &c. It might be named *N. ovalis*.

Pullastra? striato-costata (M'Coy). Pl. XIV. fig. 3.

Sp. Char. Transversely oblong, depressed, nearly twice as wide as long, dorsal and ventral margins nearly parallel, anterior and posterior ends elliptically rounded; beaks rather large, one-third of the width from the anterior end; surface with about twelve strong angular ridges parallel with the margin; those ridges are finely striated in the direction of their length.

The striation parallel with the ridging distinguishes this from the *Pullastra bistriata* (Portk.) of the Irish carb. shale, and there being no flat space between the angular ridges, and its less width and straight ventral margin, distinguish it from the *M. scalaris* (Phil.) of Devonshire. Length 2 lines, width $3\frac{1}{2}$ lines. Common in the shale of Dunvegan, N. S. Wales.

Venus? gregaria (M'Coy). Pl. XVI. fig. 5.

Sp. Char. Orbicular, compressed, evenly convex; beaks prominent, slightly nearer the anterior side; lunette deep ovate, smooth; external ligament short, prominent; surface covered with coarse rounded concentric striæ; margin crenulated within.

This pretty little species occurs gregariously in great numbers in some spots in the sandstone of Wollongong, N. S. Wales, principally as hollow casts, which at first sight resemble impressions of the *Atrypa decussata*. Length 4 lines.

(*Gasteropoda*.)

Euomphalus minimus (M'Coy). Pl. XVII. fig. 4.

Sp. Char. Greatest diameter one line; spire depressed, of three small whorls; basal whorl deeper than the spire, rounded, mouth wider than long; umbilicus small, rounded; surface smooth.

Common in the shale of Dunvegan, N. S. Wales.

Pleurotomaria subcancellata (Mor.).

In the fine calcareous sandstone of Loder's Creek, N. S. Wales.

Pleurotomaria Strzeleckiana (Mor.).

Common in the fine calcareous grits of Wollongong, N. S. Wales.

Pleurotomaria Morrisiana (M'Coy). Pl. XVII. fig. 5.

Sp. Char. Acutely conical, width four-fifths of the length; volutions four or five, each having a small double keel below the middle, and a slightly tumid margin to the sutures; no umbilicus; surface with fine close unequal striæ arched backwards from the suture to the keel. Width 4 lines, length scarcely 5 lines.

As the characters of this little species seem to have been already recognized and slightly alluded to by my friend Mr. Morris (in Count Strzelecki's work), I dedicate it to him. It is, as he observes, something like the *P. conica* (Phil.), but smaller and more elongate.

Abounds in some parts of the limestone of Black Head, N. S. Wales, and rare in the sandstone of Muree, N. S. Wales.

Platyschisma rotundatum (Mor.).

Abundant in the dark arenaceous limestone of Harper's Hill, N. S. Wales.

Platyschisma oculus (Mor.).

Common in the arenaceous limestone of Harper's Hill.

*(Pteropoda.)**Theca lanceolata* (Mor.).

Abundant in the dark arenaceous limestone of Black Head, N. S. Wales. I observe that, at the longitudinal furrows, the ends of the transverse sulci alternate with each other as in *Conularia*. Those longitudinal furrows are not noticed by Mr. Morris in his description of the genus and above-named species; but they exist, of the same number as in *Conularia*, one coinciding with the principal (? dorsal) ridge, two being placed a little on the (? posterior) side of the lateral angles, and one in the middle of the flat (? anterior) side. It is of importance to notice those obscurely marked furrows, as bringing more clearly to view the relations of the genus *Theca* with *Conularia*. The transverse sulci are crossed by very minute longitudinal striæ.

Conularia levigata (Mor.).

Common in the fine gray micaceous sandstone of Black Creek, N. S. Wales, and in the limestone of Harper's Hill, N. S. Wales.

Conularia torta (M'Coy). Pl. XVII. figs. 9 & 10.

Very elongate-conic, diminishing in diameter at the rate of one line in two inches; section oval; lateral longitudinal chan-

nels only two (?), placed with a slight obliquity to the long axis of the shell, giving it a twisted appearance, being placed at the sides (or extremities of the short axis) of the oval section at the base, and being at the ends (or extremities of the long axis) of the oval section near the small end; sides very convex, without mesial furrow; transverse sulci coarse (about fifteen in half an inch), continued uninterruptedly across from one side-furrow to the opposite.

This extraordinary fossil seems to differ from all known *Conulariæ* in having but two instead of four longitudinal furrows (for although MM. D'Archiac and Verneuil give an oval section of their *C. Brongniartii* showing but two furrows, I suppose this to be erroneous, as it neither agrees with their description nor larger figure). This is distinctly seen in the small fragment here figured, as well as the uninterrupted passage of the transverse ridges from one oblique sulcus to that on the opposite side, and the undivided nature of the intermediate faces. The larger specimen figured is not so perfect, but shows the slow rate of increase. The transverse sulci are about as numerous as in the *C. lævigata*, but that species has four unequal, divided faces, and is, together with all the described species, so different as not to require a particular comparison. The oblique or twisted direction of the longitudinal sulci above-noticed, I find also to exist in the recent *Creseis spinifera* of the Mediterranean, so that what would otherwise seem an anomalous character of the present fossil, tends rather to strengthen the affinity between *Conularia* and the recent *Pteropoda*.

Not uncommon in the sandstone of Muree, N. S. Wales.

Conularia tenuistriata (M'Coy). Pl. XVII. figs. 7 & 8.

Sp. Char. Quadrangular, pyramidal, section rhomboidal, tapering at the rate of two lines in one inch; sides unequal, two narrow sides flat or slightly convex, about half the width of the two wide ones, which are slightly concave; a strong longitudinal furrow down each of the lateral angles, and a faintly marked one in the middle of each of the broad faces; transverse striæ very fine, twenty-seven to twenty-nine in the space of half an inch, passing uninterruptedly, with a slight upward curve, across the broad faces, more nearly straight on the two narrow ones.

This species equals or even exceeds the *Conularia Gerolsteinensis* in the fineness of its transverse striation, while it is distinguished from that and all other species with which I am acquainted by the great disproportion in the width of the sides. One specimen, imperfect at both ends, measuring $1\frac{1}{2}$ inch long, had the long diameter at the base 9 lines, the short diameter at

base $4\frac{1}{2}$ lines ; long diameter at smaller end $6\frac{1}{2}$ lines, short diameter at ditto 3 lines.

Not uncommon in the sandstone of Muree, N. S. Wales.

(*Cephalopoda.*)

Bellerophon micromphalus (Mor.).

Common in the impure calcareous beds of Wollongong, N. S. Wales ; rare in the sandstone of Muree, N. S. Wales.

Bellerophon interstitialis (M'Coy). Pl. XVII. fig. 6.

Sp. Char. Globose ; keel obtuse, rounded ; surface with sharp spiral striæ, each pair having two or three finer lines between them, and the whole reticulated by sharp transverse elevated striæ, which form little tubercles at the intersections.

Closely allied to the Irish carboniferous *B. interlineatus* (Portk.), from which it is known by the strong reticulation of its surface.

Rare in the Dunvegan shale, N. S. Wales. Width 4 lines.

Nautilus.

A species resembling the carboniferous *N. sulcatus*, but too imperfect for specific determination, occurs in the Dunvegan shale, N. S. Wales.

CONCLUSION.

Having far exceeded the limits I had originally intended for the preceding part of this paper, I find it only possible to give a brief outline of those general topics on which I intended to have dwelt. First, as to what has been already done : geologists are familiar, from the labours of M. de Strzelecki and others, with the fact that there exists a series of stratified deposits, consisting of siliceous and argillaceous slates, limestones and sandstones, stretching at irregular intervals from the Liverpool range of mountains in New South Wales to the extremity of Van Diemen's Land, and forming detached masses, probably at one period continuous ; those contain abundant fossil remains of animals referable to the palæozoic period.

Above these we have a series of clays, shales and sandstones, with remains of fossil plants and beds of coal, occupying three great basin-shaped hollows ; one in the district about the Hawkesbury River in New South Wales, and called the Newcastle basin, and the two others in Van Diemen's Land, called respectively the South Esk and the Jerusalem basins. The animal beds containing the palæozoic remains are found, with one doubtful exception, to dip constantly under the coal-bearing strata, at every point of observation ; for the most part at the same angle as that at which the coal crops out : the exception alluded to is a point near Spring Hill, Van Diemen's Land, where masses of clay

containing *Pachydomus globosus* seem to rest on a sandstone containing remains of plants, and which is known to belong to the top of the coal series: Count Strzelecki, who made this observation, doubts its correctness himself, and expressly states that it needs re-examination to establish the fact of those *Pachydomus* clays really existing in this position. Nevertheless the inference has been drawn from this observation, that the Jerusalem coal-basin was much older than that at Newcastle, N. S. Wales, where the sandstones containing the *Pachydomi* were always seen to dip distinctly under the coal-measures: countenance was apparently given to this supposition by the few plants which were collected from Jerusalem coal-field proving to be all specifically and some generically distinct from those known to exist in the Newcastle basin. When to this we add, that the beds containing the fossil animal remains rest on a siliceous breccia, the age of which is unknown, and that the coal strata are overlaid by variegated sandstone and yellow limestone, supposed from its few organic remains to belong to the pleiocene period, we have I believe stated all that is known on the geological relation of those deposits.

With regard to their palæontology*, we have seven species of plants noticed in M. de Strzelecki's work by Mr. Morris, one of which is identical with a species from the Indian coal-field of Burdwan; and the general resemblance to the oolitic plants of Britain is noticed, as well as the absence of the characteristic forms of the older genuine coal-fields of Europe. In the inferior strata there are forty-eight species of animal remains noticed, one of which is supposed to be identical with a species of the British mountain limestone; the remainder are all (except two new types) of palæozoic genera; but the absence is remarked of *Nautilus*, the true *Leptæna* and *Orthidæ*, all of which however I have now been able to add.

In the above notice I have given seventeen species of fossil plants from the Mulubimba district, which is a portion of the great Newcastle and Hawkesbury basin, twelve of which are considered new. Those plants belong to ten genera, two of which (*Vertebraria* and *Zeugophyllites*) are only known here and in the supposed oolitic coal-fields of India: one genus (*Gleichenites*) I have provisionally used for the *Pecopteris odontopteroides* of Morris, from the verbal characters given by Göppert for that genus,

* Since the above was printed, I learn from a letter of Mr. Dana's that he is just putting to press his account of the palæontology of this district, which, as naturalist to the United States exploring expedition, he has recently investigated under more favourable circumstances than any of his predecessors; we may soon therefore expect from this accomplished naturalist a great addition to our knowledge on this subject.

the species of which are found only in the palæozoic coal ; the plant however agrees much better with the species of the Keuper genus *Heptacarpus* than with those of the carboniferous *Gleichenites*, and if we look rather to the plants themselves than to the definitions given of the genera, I should certainly place it there : all the other genera (with the exception of *Phyllothea*, which is confined to the locality) are well-known in the oolitic coal deposits of Yorkshire, and one species, the *Sphenopteris germana* (M'Coy), is scarcely to be distinguished from the common *Pecopteris Murrayana* (Br.) of the Scarborough shales. Several of those genera are common both to the carboniferous and oolitic periods, but the most abundant and characteristic plants of the Australian beds belong to a genus (*Glossopteris*) never found in the old coal-fields, but several species of which are, on the other hand, well-known in coal-beds of the oolitic age in various parts of the world. I am therefore strongly of opinion, from the evidence of more than double the number of species of plants known before, that the coal deposits of Australia should be referred to the oolitic period; and this opinion derives much additional weight from the negative fact, that among the large quantity of remains of plants which I have examined from this district, not a trace has been observed of any of the characteristic carboniferous genera—not a trace of *Lepidodendron* or any allied plant—not a trace of *Sigillaria*, *Favularia*, *Stigmaria*, or even of true *Calamites*. I might further add, that the list of plants I have given destroys any negative arguments formerly based on the fossil evidence, for considering the Jerusalem coal-basin to be of a different age from the Newcastle one, as I have detected the most characteristic plants of the former abundantly in the latter beds, so that the fossil evidence now would go, with the admitted identity of the walls of the basins and the general analogy of the sections, to prove them all of one age.

In the underlying rocks I have been able to determine 83 species of animal remains, of which 14 are *Zoophyta*, 3 *Crinoidea*, 4 *Crustacea*, 25 *Brachiopoda*, 24 *Lamellibranchiata*, 6 *Gastropoda*, 4 *Pteropoda* and 3 *Cephalopoda* (including *Bellerophon*). Of these, 4 genera and 32 species are figured and described as new. Those 83 species belong to 39 genera, all of which (with the exception of the genera *Tribrachyocrinus*, *Pachydomus*, *Notomya* and *Eurydesma*,—new forms at present only known in Australia) are abundant in the carboniferous rocks of Britain, many of them not being found in any higher series, and several of them not being known in any older deposits, so that the age, even if we only look to the genera of the fossils, is clearly limited to the carboniferous period ; but when we descend to the critical examination of species, we find so extraordinary and unexpected an

amount of agreement between those beds and the similar shales, sandstones and impure limestones forming the base of the carboniferous system in Ireland, that it is impossible not to believe them to be nearly on the same parallel, and there is equal difficulty in imagining them to be either younger or older than those deposits. Of those species no less than eleven are believed to be positively identical, on the most careful comparison of the Australian and Irish specimens, and nine more are so closely allied that it has been found impossible to detect any difference of character, but which, either from imperfect preservation or want of sufficient specimens to display all the characters, have not been specifically identified. With such evidence as I have mentioned, I do not think it improbable that a wide geological interval occurred between the consolidation of the fossiliferous beds which underlie the coal, and the deposition of the coal-measures themselves; that there is no real connexion between them, but that they belong to widely different geological systems, the former referable to the base of the carboniferous system, the latter to the oolitic, and neither showing the slightest tendency to a confusion of type.

EXPLANATION OF PLATES IX. to XVII.

PLATE IX.

- Fig. 1.* *Vertebraria australis* (M' Coy).
- Fig. 2.* *Otopteris ovata* (M' Coy).
- Fig. 3.* *Cyclopteris angustifolia* (M' Coy).
- Fig. 3 a.* Neuration of ditto magnified.
- Fig. 4.* *Sphenopteris flexuosa* (M' Coy).
- Fig. 4 a.* Pinnule of ditto magnified to show the neuration.
- Fig. 5.* *Glossopteris linearis* (M' Coy).
- Fig. 5 a.* Neuration of ditto magnified.
- Fig. 6.* *Pecopteris* (?) *tenuifolia* (M' Coy).

PLATE X.

- Fig. 1.* *Sphenopteris hastata* (M' Coy).
- Fig. 1 a.* Pinnule of ditto magnified.
- Fig. 2.* *Sphenopteris germana* (M' Coy).
- Fig. 2 a.* Pinnule of ditto magnified.
- Fig. 3.* *Sphenopteris plumosa* (M' Coy).
- Fig. 3 a.* Pinnule of ditto magnified.

PLATE XI.

- Fig. 1.* Inflorescence of *Phyllothea*.
- Fig. 2.* *Phyllothea ramosa* (M' Coy).
- Fig. 3.* Decorticated stem with scar of branch.
- Figs. 4 & 5.* *Phyllothea Hookeri* (M' Coy).
- Fig. 6.* Magnified part of leaf of ditto to show the midrib.
- Fig. 7.* Stems of ditto, without their sheath, to show their sulcation.
- Fig. 8.* *Cladochonus tenuicollis* (M' Coy). Lower figure magnified.
- Fig. 9.* *Strombodes*, (?) *australis* (M' Coy).

PLATE XII.

- Fig. 1 a.* *Brachymetopus Strzeleckii* (*M'Coy*): head natural size and magnified.
Fig. 1 b. Ditto, pygidium natural size and magnified.
Fig. 2 a & b. *Tribrachyocrinus Clarkii* (*M'Coy*).
Fig. 2 c. Plates of ditto expanded.

PLATE XIII.

- Fig. 1.* *Orbicula affinis* (*M'Coy*).
Fig. 2. *Producta undulata* (*M'Coy*).
Fig. 3. *Orthis spinigera* (*M'Coy*).
Fig. 4. *Orthis australis* (*M'Coy*).
Fig. 4 a. Ditto, internal cast.
Figs. 5 & 6. *Spirifera* (*Brachythyris*) *oviformis* (*M'Coy*).
Fig. 7. *Spirifera lata* (*M'Coy*).
Fig. 8. *Atrypa Jukesii* (*M'Coy*).
Figs. 9 & 9 a. *Atrypa biundata* (*M'Coy*).

PLATE XIV.

- Fig. 1.* *Inoceramus Mitchellii* (*M'Coy*).
Fig. 2. *Pecten ptychotis* (*M'Coy*).
Fig. 3. *Pullastra* (?) *striato-costata* (*M'Coy*).
Fig. 4. *Pachydomus ovalis* (*M'Coy*).
Fig. 5. *Pachydomus sacculus* (*M'Coy*).

PLATE XV.

- Fig. 1.* *Cardinia* (?) *exilis* (*M'Coy*).
Figs. 2 & 3. *Modiola crassissima* (*M'Coy*).
Fig. 4. *Notomya clavata* (*M'Coy*).
Figs. 5 & 5 a. *Notomya securiformis* (*M'Coy*).

PLATE XVI.

- Fig. 1.* *Pachydomus* (?) *pusillus* (*M'Coy*): internal cast.
Fig. 2. Ditto, surface.
Fig. 3. *Pachydomus gigas* (*M'Coy*).
Fig. 4. *Pleurorhynchus australis* (*M'Coy*).
Fig. 5. *Venus* (?) *gregaria* (*M'Coy*).

PLATE XVII.

- Fig. 1.* *Pecten subquinquelineatus* (*M'Coy*).
Fig. 2. *Spirifera* (*Brachythyris*) *duodecimcostata*, dorsal valve.
Fig. 3. Ditto, ventral valve.
Fig. 4. *Euomphalus minimus* (*M'Coy*).
Fig. 5. *Pleurotomaria Morrisiana* (*M'Coy*).
Fig. 6. *Bellerophon interstitialis* (*M'Coy*).
Fig. 7. *Conularia tenuistriata* (*M'Coy*).
Fig. 8. Ditto.
Figs. 9 & 10. *Conularia torta* (*M'Coy*).

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